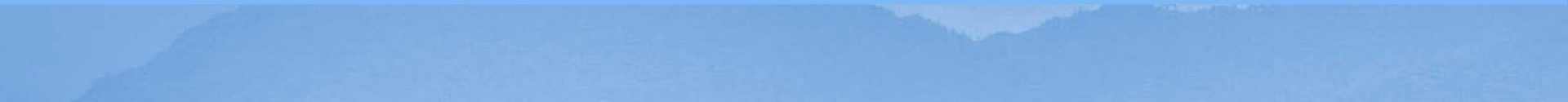


# ***Volcanoes***



# Arizona Volcanoes

- Arizona is a great state to study volcanoes!
  - The three major kinds of volcanoes are all present in this state
- Stratovolcanoes can be found in the northern part of the state and Cinder Cones in the northern, eastern and western parts
- Shield volcanoes are located west of Phoenix



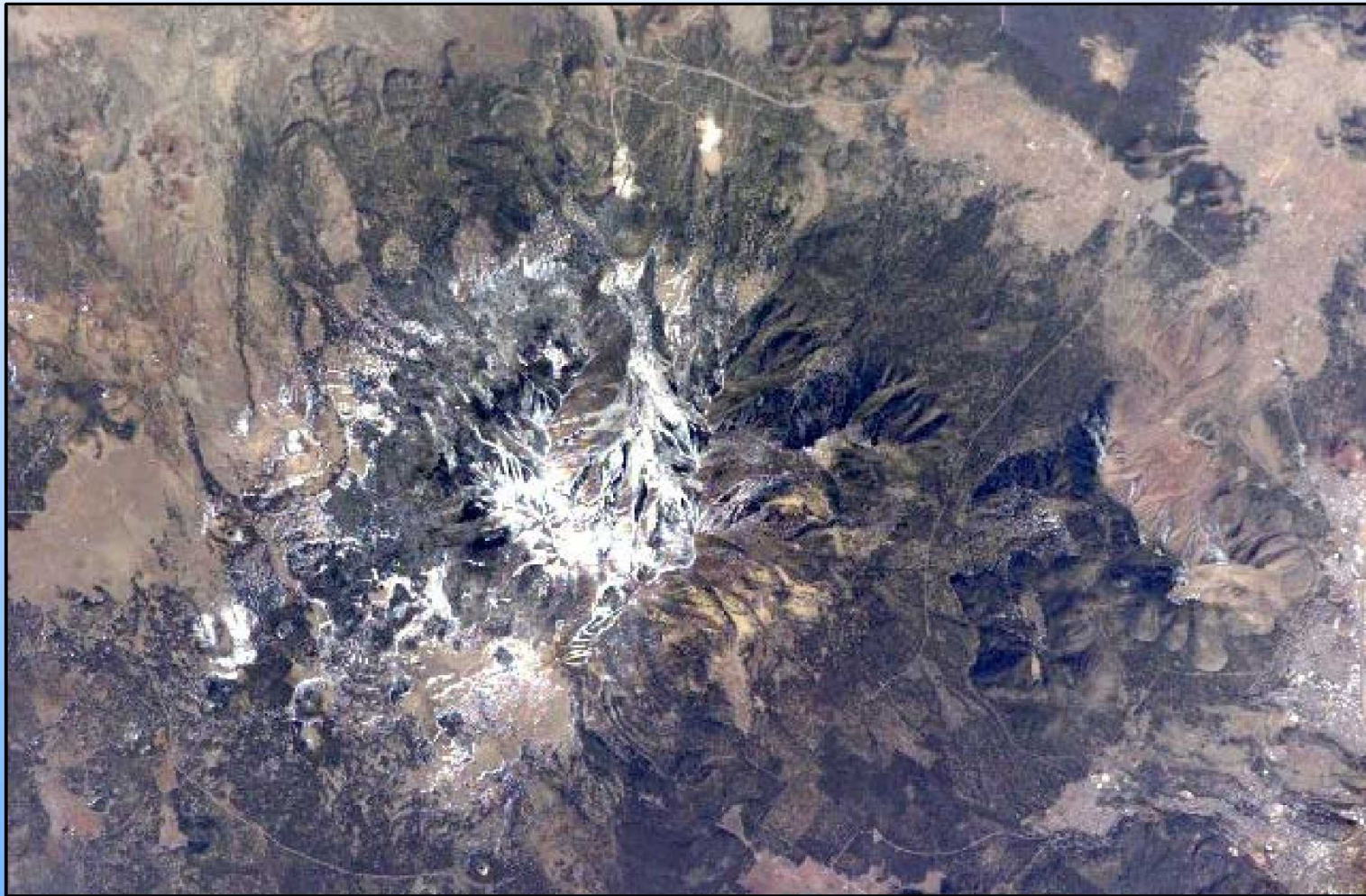
# San Francisco Volcanic Field



- Many of the hills and mountains between Flagstaff and the Grand Canyon are geologically young (6 million years old) and extinct volcanoes of the San Francisco Volcanic Field
- San Francisco Peaks are the remains of eroded stratovolcanoes
- Humphrey's Peak Is the highest point in Arizona at 12,633 feet



# Humphrey's Peak from the ISS



ISS014-E-  
17325



# Sunset Crater

- Part of the San Francisco Volcanic Field in northern Arizona
- Is a type of volcano known as a cinder cone
- The state's youngest volcano
- Thought to have erupted in 1064 AD



# Sunset Crater from the ISS



ISS014-E-7244

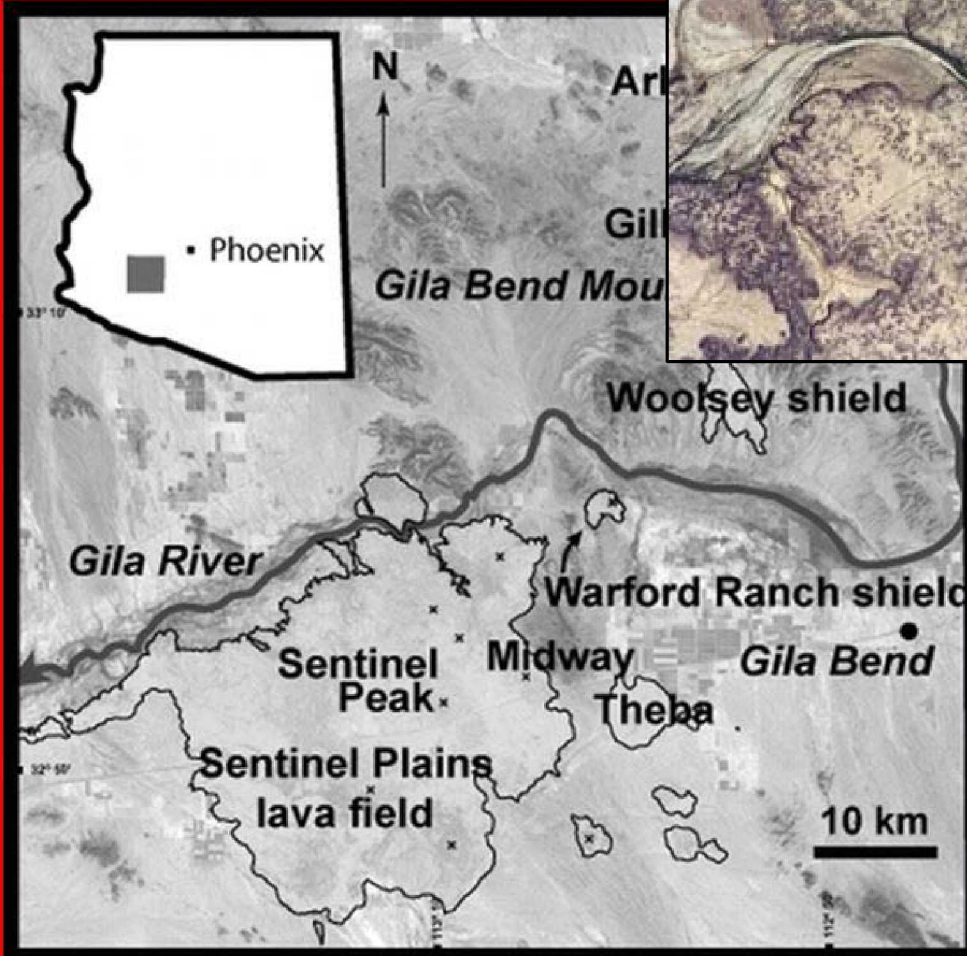


# Shield Volcanoes in Southwestern Arizona

- Found within the Sentinel-Arlington Volcanic Field
- 18 low shield volcanoes
- Located 60 – 70 km west of Phoenix







ISS017-E-9598,  
Sentinel Volcanic  
Field

# What is the difference between a mountain and a volcano?

- ▣ Volcanoes are not formed by folding, crumpling, uplift or erosion
- ▣ Volcanoes are built by accumulation of their own eruptive products

# Types of Volcanoes

## ❖ Shield volcano

- ❑ Broad, slightly domed
- ❑ Primarily made of basaltic (fluid) lava
- ❑ Generally large size
- ❑ e.g., Mauna Loa in Hawaii





# Island of Hawaii



STS099-701-8,  
100 mm, Feb. 2002

# Galapagos Islands



ISS004-E-13314, Galapagos Islands

ISS005-E-6997



# Cinder Cones

- Built from ejected lava fragments
- Steep slope angle
- Rather small size
- Frequently occur in groups
- Usually a product of relatively gas-rich basaltic magma





# Stratovolcanoes

- ▣ Also called composite cones
- ▣ Most are adjacent to the Pacific Ocean
- ▣ Large size
- ▣ Interbedded lavas and pyroclastics
- ▣ Most violent type of activity



# Mt. St. Helens –stratovolcano



# Mt. St. Helens following the 1980 eruption





# Mt. St. Helens







# Mt. St. Helens



ISS011-E-  
13762,  
180 mm,  
Sept. 28,  
2005





ISS005-E-8020, 800 mm, 07/02/2001, Mt. St. Helens

# Stratovolcanoes

- Often produce nuée ardente
  - Fiery pyroclastic flow made of hot gases infused with ash
  - Flows down sides of a volcano at speeds up to 200 km (125 miles) per hour
- May produce a lahar - volcanic mudflow
  - Generally follow gullies and stream valleys
  - Can be generated when large volumes of ice and snow melt during an eruption
  - Others are generated when heavy rainfall saturates weathered volcanic debris
  - Lahars can be reactivated after an eruption



# Mt. Pinatubo, Philippines - Lahars



STS090-E-707-28,  
250 mm, April 24,  
1998



# Cascade Range

Mt. Rainier

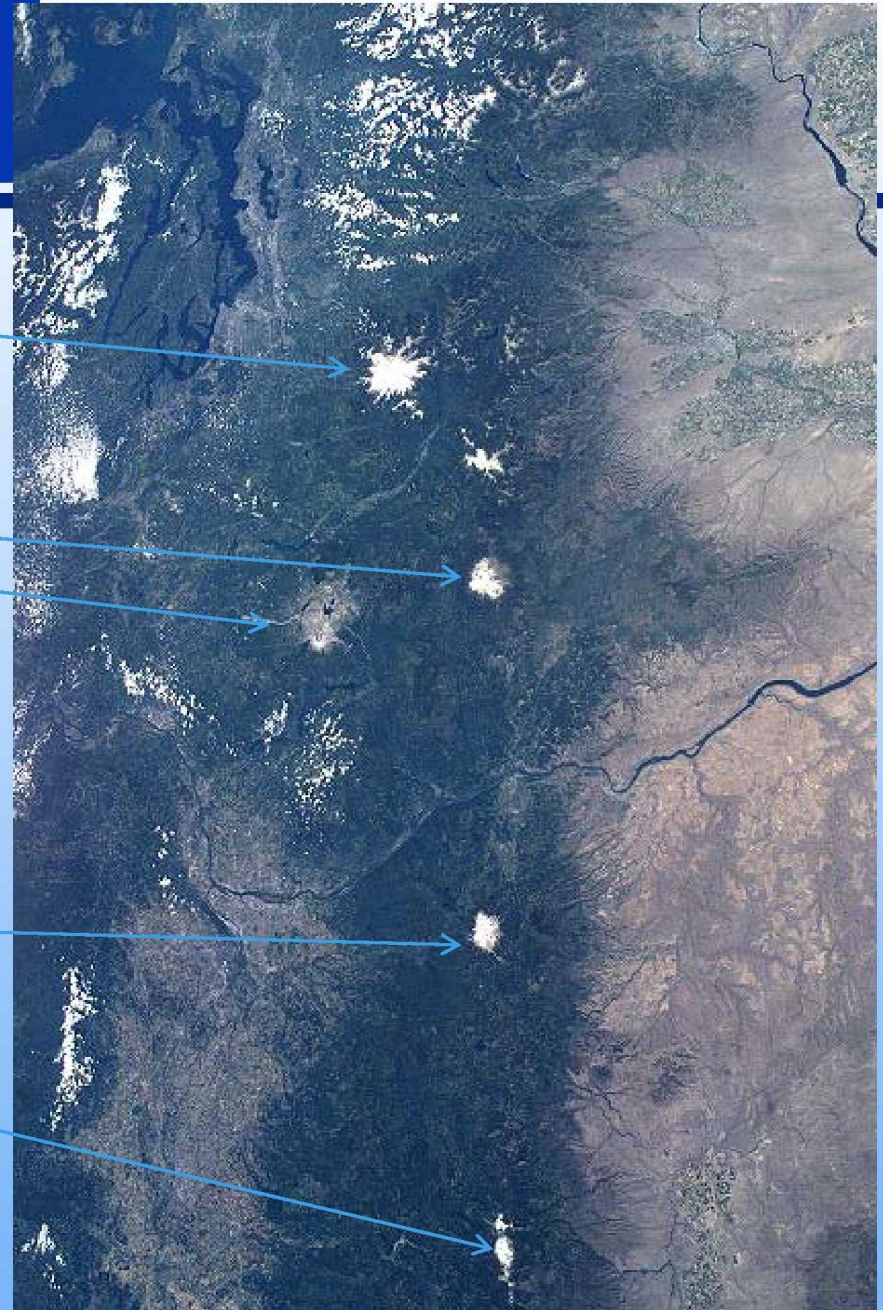
Mt. Adams

Mt. St. Helens

Mt. Hood

Mt. Jefferson

ISS002-E-8293,  
35mm, July 6, 2001





# Where Does The Magma Come From ?

- ❖ Magma originates when essentially solid rock, located in the crust and upper mantle, melts
- ❖ Factors that influence the generation of magma from solid rock
  - Role of heat
    - ▣ Earth's natural temperature increases with depth (geothermal gradient) is not sufficient to melt rock at the lower crust and upper mantle



# Magma

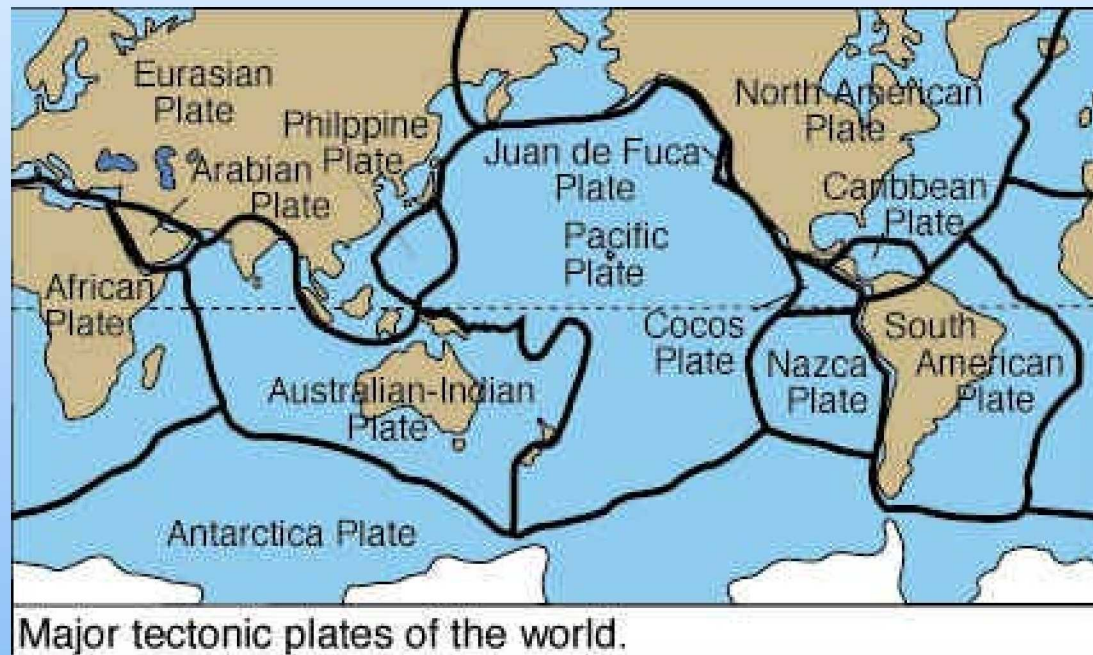
- Role of heat
  - ▣ Additional heat is generated by
    - Friction in subduction zones
    - Crustal rocks heated during subduction
      - hydrous minerals plays a big role in lowering the melting point of upper mantle and lower crustal materials to create magma



# Distribution of Volcanoes

- ❖ Global distribution of volcanoes is not random
  - Most volcanoes are located on the margins of the ocean basins (intermediate, andesitic composition)
  - Second group is confined to the deep ocean basins (basaltic lavas)
  - Third group includes those found in the interiors of continents

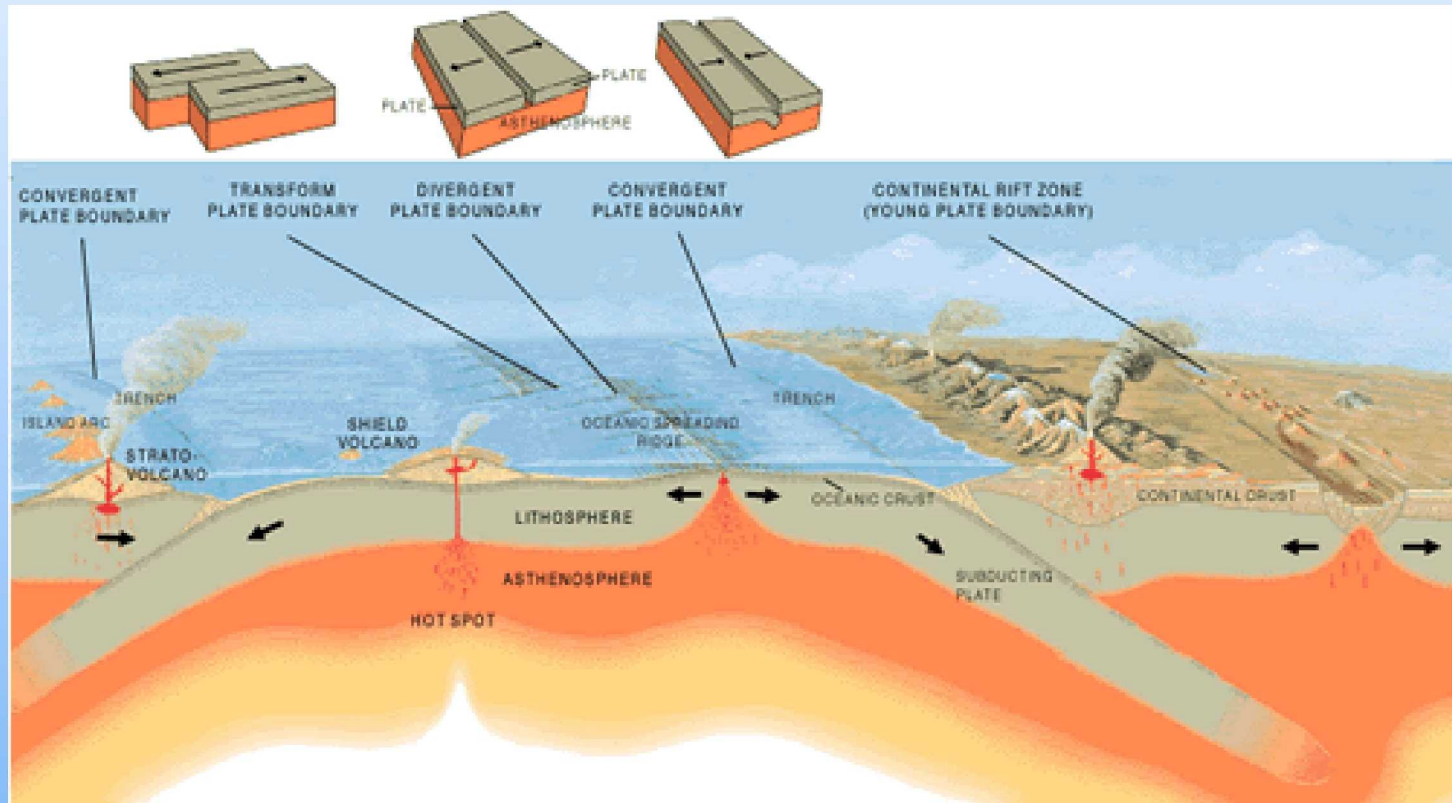
# Earth's Major Plates



Ritter, Michael E. The Physical Environment: an Introduction to Physical Geography. 2006. Date visited, 12/16/2009. [http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/title\\_page.html](http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/title_page.html)



# Convergent, Divergent, Boundaries

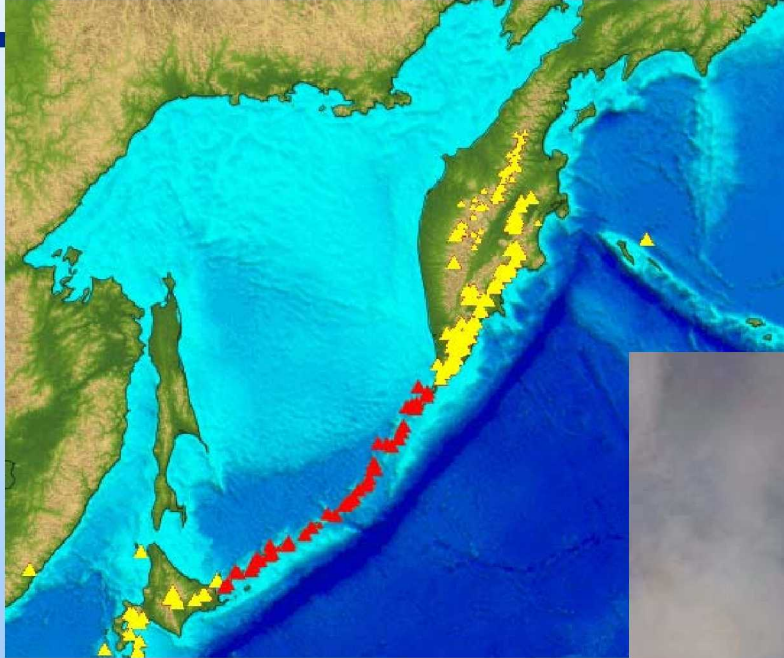


From *The Dynamic Earth*, USGS Publication

# Plate tectonics and volcanoes

- ❖ Plate motions provide the mechanism by which mantle rocks melt to form magma
  - Convergent plate boundaries
    - ▣ Descending plate partially melts
    - ▣ Magma slowly rises upward
    - ▣ Rising magma can form
      - Volcanic island arcs in an ocean
        - ▣ Develop roughly parallel to the associated trench

# Sarychev Volcano, Kuril Islands



# Plate tectonics and volcanoes

- Continental volcanic arcs (Andes Mountains)
  - Through the assimilation of silica-rich crustal rocks a magma body may change composition as it rises through continental crust





# Plate tectonics and volcanoes

- ❖ Plate motions provide the mechanism by which mantle rocks melt to form magma
  - Divergent plate boundaries
    - ▣ The greatest volume of volcanic rock is produced along the oceanic ridge system
      - Lithosphere pulls apart
      - Less pressure on underlying rocks
      - Partial melting occurs
      - Large quantities of fluid basaltic magma are produced

# Plate tectonics and volcanoes

- ❖ Plate motions provide the mechanism by which mantle rocks melt to form magma
  - Intraplate igneous activity
    - ▣ Activity within a rigid plate
    - ▣ Plumes of hot mantle material rise
    - ▣ Form localized volcanic regions called hot spots
    - ▣ Examples include the Hawaiian Islands and the Columbia River Plateau in the northwestern United States

# Volcanoes Review – What Kind of Volcanoes are These?

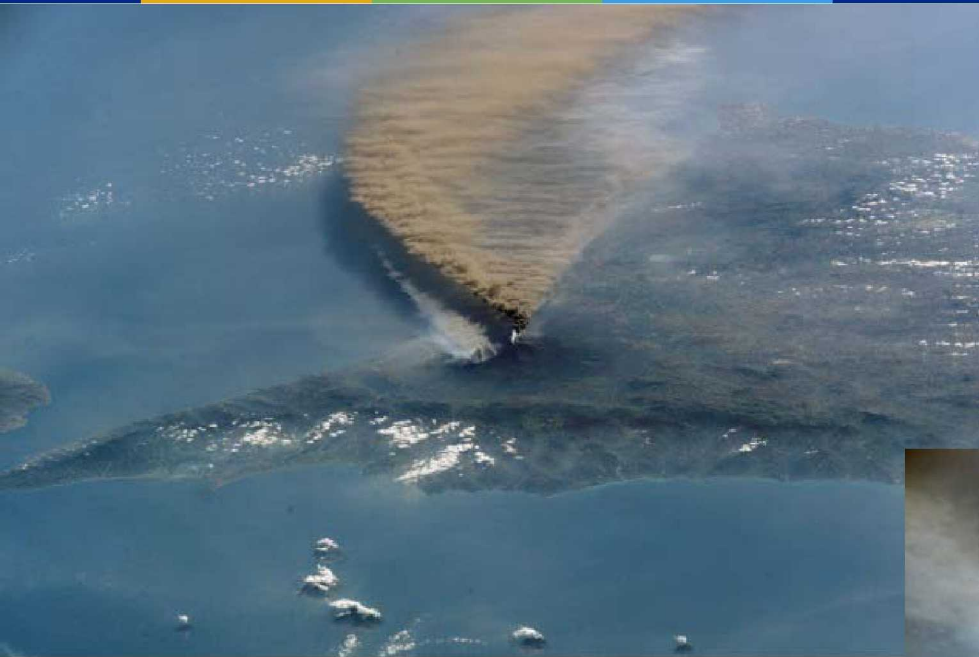


STS110-E-5751, 400 mm,  
April 15, 2002

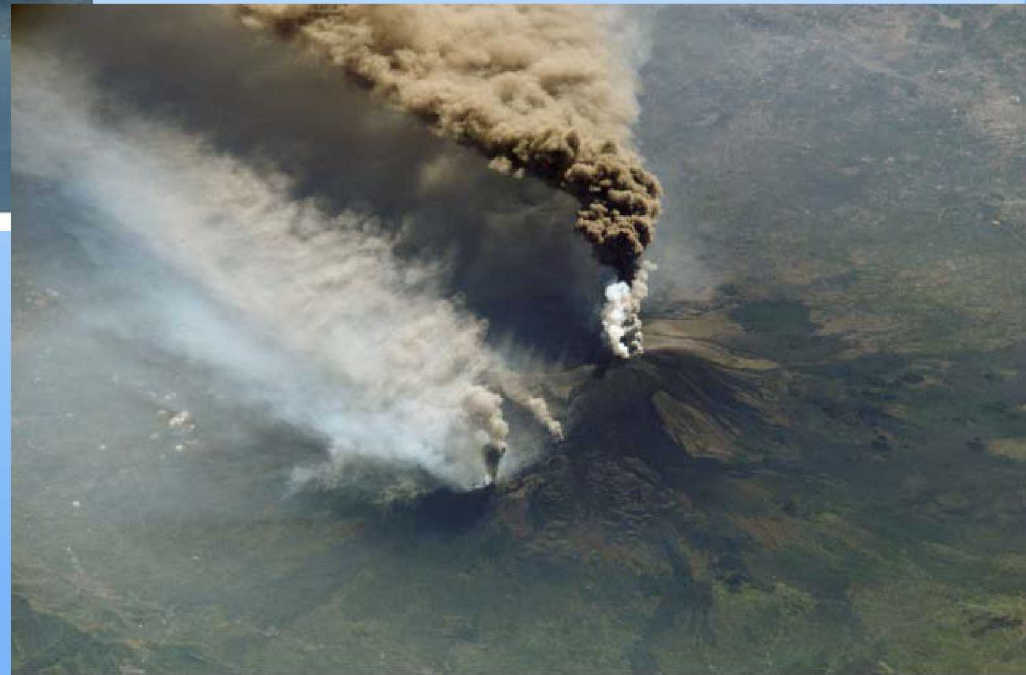
ISS004-E-11488, 400 mm,  
May 2, 2002



# Mt. Etna, Sicily



800 mm, Oct. 30, 2002



200 mm, Oct. 30, 2002

ISS005E19022

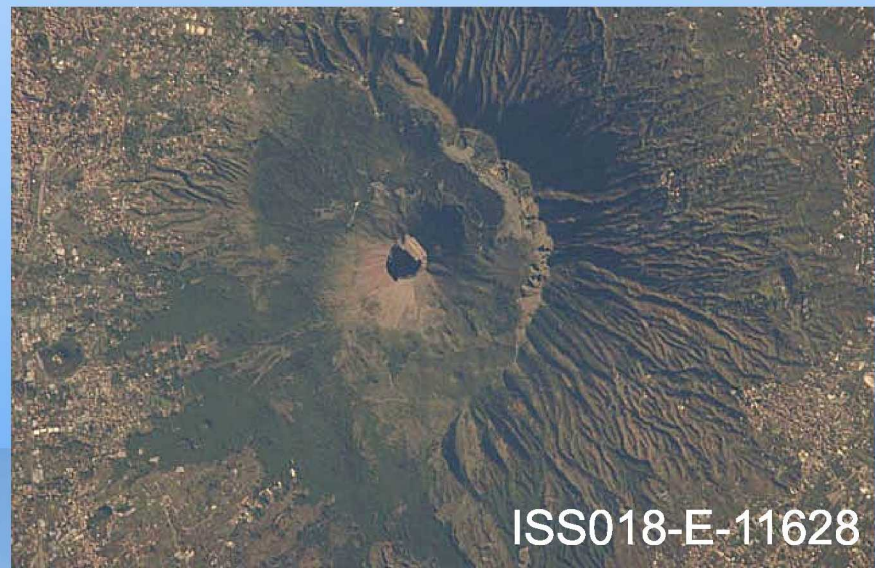




ISS004-E-8668



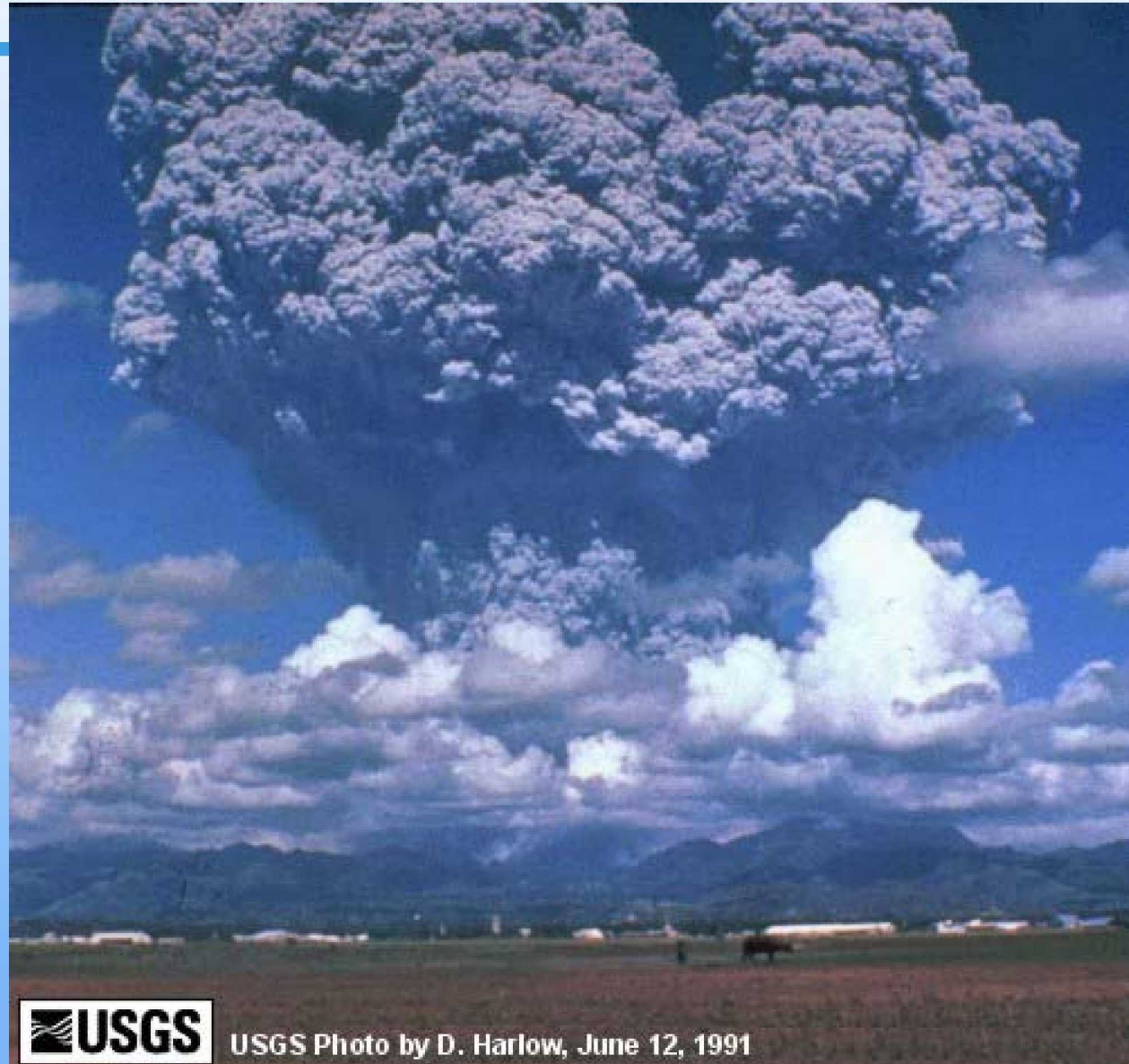
ISS004-E-11628



ISS018-E-11628



# Mount Pinatubo, Philippines



# Damage from Mount Pinatubo Eruption



# Questions??

